

Information Bulletin

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Title: Awareness of Historical Information During Internal Dose Evaluations

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Lessons Learned Summary: Workers responsible for internal dosimetry programs and internal dosimetrists should be alert to the possibility that current indications of positive bioassay results may be due to intakes from radioactive materials that occurred years prior to the current examination. Intakes of moderately to highly insoluble plutonium that have been undetectable for years or even decades may become detectable during in vivo chest counting due primarily to the ingrowth of americium-241 (241Am) from plutonium-241 (241Pu) over time. Changes in equipment type and detection limits may also contribute to increased detection of historic intakes that have previously been undetected.

Discussion of Activities: A Hanford worker returning to work in 2006 after a year-long medical leave had a detection of americium-241 (241Am) confirmed on a chest count. The 241Am results were slightly above the detection level. A review of the worker's work history indicated no potential for intake of 241Am or 239Pu since the late 1980s, when he worked in a plutonium facility. After a thorough review of the worker's bioassay results, a review of the historical radiation dosimetry records for this worker and for the events the worker was involved in, and an interview with the worker, it was concluded that an event in 1980 involving a plutonium scrap metal fire at the plutonium facility was the most likely source of exposure to moderately to highly insoluble plutonium.

Analysis: A part of any investigation for a positive bioassay result is a detailed review of recent work history for the worker involved. However, this case is unique in that the worker had just returned from a medical leave from work that lasted slightly longer than one year. From 1989 through 2003, the worker was not participating in a routine bioassay program due to his work assignments not requiring it. From 1979 through 1989, the worker was assigned to a plutonium facility. Historical radiation records and interviews with the worker indicate that the worker was involved in two events at the plutonium facility (in 1980 and 1985) where 239Pu was released and where there was a potential for intake of moderately to highly insoluble plutonium. The historical dosimetry records indicated that both chest counts for 241Am and urinalysis for 239Pu were done after the 1980 event with no positive detections confirmed at that time. There was a slightly positive detection of 241Am in the chest count after the 1985 event, with slightly positive detection of 239Pu in the urinalysis. An intake was confirmed at that time. However, since the estimated organ dose was below the action level of that time of 1% of a maximum permissible body burden (i.e., 15 rem per year to the lung), no internal dose was assigned. Since the 1985 event, both chest counts and plutonium urinalysis have been below detection limits. No bioassay results were available for the years 1989 to 2003. The baseline bioassays done in 2003 showed no detection of 241Am in the chest count and no detection of 239Pu in the plutonium urinalysis. It wasn't until the baseline bioassays done in 2006 when the worker returned from a year-long medical leave that a positive detection of 241Am in the chest count was found.

The airborne material from the 1980 event was assumed to have a solubility mixture of 30% Class Y and 70% Super Class Y based on the internal dosimetry assessment done on the most highly contaminated worker from that event. The ingrowth of ²⁴¹Am has been seen in other published cases of intakes of highly insoluble (or Super Class Y) plutonium. In this particular case, the ingrowth of ²⁴¹Am over time lead to amounts that are just now becoming detectable after 25 years. Using current biokinetic models, a 50-year committed effective dose equivalent (CEDE) of 6.8 rem was calculated. The 50-year committed dose equivalent to the lung was 43 rem. While the estimated CEDE value exceeds current regulatory limits, the regulatory limits for the year of intake have not been exceeded. Using current regulatory guidance, the effective and organ doses will be assigned to 1980, the year of intake.

Recommendations:

1. While this is a unique case, it highlights the need to include the following when investigating any positive bioassay result:
 - a. Thorough review of all employee's historical work-related records
 - b. Interview with the worker(s)
 - c. Detailed look at current and previous bioassay results
 - d. Review facilities and processes where the worker was employed
 - e. Radionuclides and radioactive material solubility in use at the facilities worked
 - f. Worker involvement in documented incidents such as CAM alarms or high air samples, contamination spreads, skin contamination, puncture wounds, etc.
2. If it is concluded that there is no possibility of an intake occurring in the current calendar year, be sure to investigate worker's entire work history. There may have been an event that occurred years or decades earlier where exposure to moderately or highly insoluble plutonium occurred but was below detection limits used at that time.

Cost Savings/Avoidance: Not determined

Work Function: Radiological Protection

Hazards: Personal Injury/Exposure - Radiation

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References: None